when that River was frozen over for ſeveral Miles, and Booths and Streets were made on the Ice, an Ox roaſted thereon, &c. For the loweſt Point of Freezing in 1716, was on *January* 7, when the Spirits fell to 35 Degrees only of the Glaſs I now make uſe: But the true Cauſe of the freezing of the *Thames* that Year was not barely the Exceſs of the Cold, but the long Continuance of it: Which was alſo the principal Cauſe of thoſe remarkable Congelations of that River in 1683 and 1708, when I ſaw Coaches driven over the Ice, large Fires made on it, &c. I am, with great Reſpect,

Honoured SIR,

Upminſter, Feb. 13th, 173$\frac{0}{1}$.

Yours,

WILLIAM DERHAM.

V. *A Letter to* Cromwell Mortimer, *M. D. Secr. R. S. containing ſeveral Experiments concerning* Electricity; *by Mr.* Stephen Gray.

SIR,

IN the Year 1729 I communicated to Dr. *Deſaguliers*, and ſome other Gentlemen, a Diſcovery I had then lately made, ſhewing that the Electrick Vertue of a Glaſs Tube may be conveyed to any other Bodies, ſo as to give them the ſame Property of attracting

ing and repelling light Bodies, as the Tube does, when excited by rubbing; that this attractive Vertue might be carried to Bodies that were many Feet diſtant from the Tube. On *May* the 1ſt Dr *Deſaguliers* made a Report of the Experiments he had ſeen, to the *Royal Society*; I then promiſed to communicate a more particular Account of theſe Experiments to the *Society*; but as I was the next Day to go into the Country, where I knew that I ſhould have the Opportunity of carrying on the Experiments much farther than I had yet done, for want of Room in my Chamber, which was not large enough for carrying on ſeveral other Experiments I had in View; I was willing, as I had begun the Diſcovery, to carry it on as much farther as I could, before I communicated it to the *Royal Society*, which I now humbly offer to their Conſideration.

In *February* 172⅞, I repeated ſome of the Experiments I had formerly made, in the firſt Diſcovery of an Electrical Attraction in many Bodies, not before known to have that Property, which I communicated to the *Royal Society*. An Account of thoſe Experiments is given in the *Philoſophical Tranſactions*, N° 366. I made ſeveral Attempts on the Metals, to ſee whether they might not be made attractive by the ſame Method as other Bodies were, *viz.* by heating, rubbing and hammering, but without any Succeſs: I then reſolved to procure me a large Flint-Glaſs Tube, to ſee if I could make any farther Diſcovery with it, having called to Mind a Suſpicion which ſome Years ago I had, that as the Tube communicated a Light to Bodies, when it was rubbed in the Dark, whether it might not at the ſame Time communicate an Electricity to them, though

I never till now tried the Experiment, not imagining the Tube could have ſo great and wonderful an Influence, as to cauſe them to attract with ſo much Force, or that the Attraction would be carried to ſuch prodigious Diſtances, as will be found in the Sequel of this Diſcourſe.

Before I proceed to the Experiments, it may be neceſſary to give a Deſcription of the Tube: Its Length is three Feet five Inches, and near one Inch two Tenths in Diameter: I give the mean Dimenſions, the Tube being larger at each End than in the Middle, the Bore about one Inch. To each End I fitted a Cork, to keep the Duſt out when the Tube was not in uſe.

The firſt Experiment I made, was to ſee if I could find any Difference in its Attraction, when the Tube was ſtopped at both Ends by the Corks, or when left open, but could perceive no ſenſible Difference; but upon holding a Down-Feather over againſt the upper End of the Tube, I found that it would go to the Cork, being attracted and repelled by it, as by the Tube when it had been excited by rubbing. I then held the Feather over againſt the flat End of the Cork, which attracted and repelled many Times together; at which I was much ſurprized, and concluded that there was certainly an attractive Vertue communicated to the Cork by the excited Tube.

Having by me an Ivory Ball of about one Inch three Tenths Diameter, with a Hole through it, this I fixed upon a Fir-Stick about four Inches long, thruſting the other End into the Cork, and upon rubbing the Tube, found that the Ball attracted and repelled the Feather with more Vigour than the Cork had done, repeat-

repeating its Attractions and Repulſions for many Times together: I then fixed the Ball on longer Sticks, firſt upon one of eight Inches, and afterwards upon one of twenty-four Inches long, and found the Effect the ſame. Then I made uſe of firſt Iron, and then Braſs Wire, to fix the Ball on, inſerting the other End of the Wire in the Cork, as before, and found that the Attraction was the ſame as when the Fir-Sticks were made uſe of, and that when the Feather was held over againſt any Part of the Wire, it was attracted by it; but though it was then nearer the Tube, yet its Attraction was not ſo ſtrong as that of the Ball. When the Wire of two or three Feet long was uſed, its Vibrations, cauſed by rubbing the Tube, made it ſomewhat troubleſome to be managed: This put me upon thinking, whether if the Ball was hung by a Packthread, and ſuſpended by a Loop on the Tube, the Electricity would not be carried down the Line to the Ball: I found it to ſucceed accordingly; for upon ſuſpending the Ball on the Tube by a Packthread about three Feet long, when the Tube had been excited by rubbing, the Ivory Ball attracted and repelled the Leaf-Braſs, over which it was held, as freely as it had done, when it was ſuſpended on Sticks or Wire; as did alſo a Ball of Cork, and another of Lead that weighed one Pound and a quarter.

After I had found that the ſeveral Bodies above-mentioned had an Electricity communicated to them, I then went on to ſee upon what other Bodies the Tube would have the ſame Effect, beginning with the Metals, ſuſpending them on the Tube by the Method above-mentioned; firſt in ſmall Pieces, as with a Guinea, a Shilling, a Half-penny, a Piece of Block-Tin,

a Piece of Lead; then with larger Quantities of Metal, ſuſpending them on the Tube by Packthread. Here I made uſe of a Fire-Shovel, Tongs, and Iron Poker, a Copper Tea-Kettle, which ſucceeded the ſame, whether empty, or full of either cold or hot Water; a Silver Pint Pot; all which were ſtrongly Electrical, attracting the Leaf-Braſs to the Hight of ſeveral Inches. After I had found that the Metals were thus Electrical, I went on to make Trials on other Bodies, as Flint-Stone, Sand-Stone, Load-Stone, Bricks, Tiles, Chalk; and then on ſeveral vegetable Subſtances, as well green as dry, and found that they had all of them an Electrick Vertue communicated to them, either by being ſuſpended on the Tube by a Line, or fixed on the End of it by the Method above-mentioned.

I next proceeded to try at what greater Diſtances the Electrick Vertue might be carried, and having by me Part of a hollow walking Cane, which I ſuppoſe was Part of a Fiſhing-Rod, two Feet ſeven Inches long; I cut the great End of it, to fit it into the Bore of the Tube, into which it went about five Inches; then when the Cane was put into the End of the Tube, and this excited, the Cane drew the Leaf-Braſs to the Hight of more than two Inches, as did alſo the Ivory Ball, when by a Cork and Stick it had been fixed to the End of the Cane. A ſolid Cane had the ſame Effect, when inſerted in the Tube after the ſame Manner as the hollow one had been. I then took the two upper Joints of a large Fiſhing-Rod, the one of *Spaniſh* Cane, the other partly Wood and the upper End Whale-bone, which, together with the Tube, made a Length of more than fourteen Feet. Upon the leſſer End

End of the Whale-bone was fixed a Ball of Cork of about an Inch and quarter Diameter; then the great End of the Rod being inſerted in the Tube, the Leaf-Braſs laid on the Table, and the Tube excited, the Ball attracted the Leaf-Braſs to the Hight of about three Inches by Eſtimation. With ſeveral Pieces of *Spaniſh* Cane and Fir-Sticks I afterwards made a Rod, which, together with the Tube, was ſomewhat more than eighteen Feet long, which was the greateſt Length I could conveniently uſe in my Chamber, and found the Attraction very nearly, if not altogether as ſtrong, as when the Ball was placed on ſhorter Rods. Thus far I proceeded before I went into the Country, which I did the 2d of *May*, 1729, taking with me ſeveral Glaſs Canes, and ſuch other Materials I thought would be neceſſary, and could not well be procured there. I ſhall now give an Account of the Experiments I then made, ſome of which were made at *Norton-Court* near *Feverſham* in *Kent*, at my honoured Friend's *John Godfrey*'s, Eſq; the other at *Otterden-Place*, at my honoured Friend's *Granvil Wheler*'s, Eſq; a worthy Member of the *Royal Society*, with whom I have had the Honour to be lately acquainted. I ſhall ſet down each Experiment in the Order of the Time and Place they were made, as I find it in my Notes.

The firſt Experiment was made at *Norton-Court*, *May* 14th, 1729, between ſix and ſeven o'Clock in the Evening. Having provided a Rod of about twenty-four Feet, that conſiſted of a Fir-Pole, of Cane, and the Top of Reed, upon the End of which the Ball of Cork was placed, and the great End of the Rod put into the Tube about ſeven or eight Inches; then the Leaf-

Leaf-Braſs being laid down, and the Tube rubbed, the Ball attracted and repelled the Leaf-Braſs with Vigour; ſo that it was not at all to be doubted, but with a longer Pole the Electricity would have been carried much farther.

May the 16th, I made a Rod thirty-two Feet long, including the Tube; the bigger Part of it was a Fir-Staff about ſix Feet and a half long, the reſt was of Cane, and Reed for the top Part of it. All Things being prepared, as before, the Effect was the ſame as in the laſt Experiment, only the Pole bending ſo much, and vibrating by rubbing the Tube, made it more troubleſome to manage the Experiment. This put me upon making the following Experiments.

May the 19th, about ſix in the Morning, the Ivory Ball being ſuſpended on the Tube, by a Line of Pack-thread twenty-ſix Feet long, which was the Hight, I ſtood at in the Balcony, from the Court where he ſtood, that held the Board with the Leaf-Braſs on it; then the Tube being rubbed, attracted the Leaf-Braſs to the Hight of near two Inches, as he that aſſiſted informed me. This was repeated with the Cork Ball with the ſame Succeſs.

May the 31ſt, in the Morning, to a Pole of eighteen Feet there was tied a Line of thirty-four Feet in Length; ſo that the Pole and Line together were fifty-two Feet. With the Pole and Tube I ſtood in the Balcony, the Aſſiſtant below in the Court, where he held the Board with the Leaf-Braſs on it; then the Tube being excited as uſual, the Electrick Vertue paſſed from the Tube up the Pole, and down the Line to the Ivory Ball, which attracted the Leaf-Braſs, and as the Ball

paſſed

paſſed over it in its Vibrations, the Leaf-Braſs would follow it, till it was carried off the Board: But theſe Experiments are difficult to make in the open Air, the leaſt Wind that is ſtirring, carrying away the Leaf-Braſs.

Some Time after I made ſeveral Attempts to carry the Electrick Vertue in a Line horizontally, ſince I had not the Opportunity here of carrying it from greater Hights perpendicularly, but without Succeſs, for want of then making uſe of proper Materials, as will appear from what follows. The firſt Method I made Trial of, was by making a Loop at each End of a Line, and hanging it on a Nail drove into a Beam, the other End hanging downwards, through the Loop at this End the Line with the Ivory Ball was put; the other End of this Line was by a Loop hung on the Tube; ſo that that Part of the Line next the Ball hung Perpendicular, the reſt of the Line Horizontal: Then the Leaf-Braſs being laid under the Ball, and the Tube rubbed, yet not the leaſt Sign of Attraction was perceived. Upon this I concluded, that when the Electrick Vertue came to the Loop that was ſuſpended on the Beam, it went up the ſame to the Beam; ſo that none, or very little of it at leaſt, came down to the Ball, which was afterwards verified, as will appear by the Experiments that will be mentioned hereafter. Upon this I gave over making any farther Attempts of carrying the Electricity horizontally, deſigning at my Return to *London*, if I could get Aſſiſtance, to have tried the Experiment from the Top of the Cupola of St. *Paul*'s, not doubting but the Electrick Attraction

would be carried down perpendicular, from thence to the Ground.

June the 30th, 1729, I went to *Otterden-Place*, to wait on Mr. *Wheler*, carrying with me a ſmall ſolid Glaſs Cane of about eleven Inches long, and ſeven eighth Parts of an Inch in Diameter, with ſome other requiſite Materials, deſigning only to give Mr. *Wheler* a Specimen of my Experiments. The firſt was from the Window in the Long Gallery that opened into the Hall, the Hight about ſixteen Feet; the next from the Battlements of the Houſe down into the fore Court, twenty-nine Feet; then from the Clock-Turret to the Ground, which was thirty-four Feet, this being the greateſt Hight we could come at; and notwithſtanding the Smallneſs of the Cane, the Leaf-Braſs was attracted and repelled beyond what I expected. As we had no greater Hights here, Mr. *Wheler* was deſirous to try whether we could not carry the Electrick Vertue horizontally. I then told him of the Attempt I had made with that Deſign, but without Succeſs, telling him the Method and Materials made uſe of, as mentioned above. He then propoſed a Silk Line to ſupport the Line, by which the Electrick Vertue was to paſs. I told him it might do better upon the Account of its Smallneſs; ſo that there would be leſs Vertue carried from the Line of Communication, with which, together with the apt Method Mr. *Wheler* contrived, and with the great Pains he took himſelf, and the Aſſiſtance of his Servants, we ſucceeded far beyond our Expectation.

The firſt Experiment was made in the matted Gallery *July* 2, 1729, about Ten in the Morning. About four Feet

Feet from the End of the Gallery there was a croſs Line that was fixed by its Ends to each Side of the Gallery by two Nails; the middle Part of the Line was Silk, the reſt at each End Packthread; then the Line to which the Ivory Ball was hung, and by which the Electrick Vertue was to be conveyed to it from the Tube, being eighty Feet and a half in Length, was laid on the croſs Silk Line, ſo as that the Ball hung about nine Feet below it: Then the other End of the Line was by a Loop ſuſpended on the Glaſs Cane, and the Leaf-Braſs held under the Ball on a Piece of white Paper; when the Tube being rubbed, the Ball attracted the Leaf-Braſs, and kept it ſuſpended on it for ſome Time.

This Experiment ſucceeding ſo well, and the Gallery not permitting us to go any farther in one Length, Mr. *Wheler* thought of another Expedient, by which we might encreaſe the Length of our Line, which was by putting up another croſs Line near the other End of the Gallery; and over the Silk Part of both the Lines there was laid a Line that was long enough to be returned to the other End, where the Ball hung; and though now both Ends of the Line were at the ſame End of the Gallery, yet Care was taken that the Tube was far enough off from having any Influence upon the Leaf-Braſs, except what paſſed by the Line of Communication: Then the Cane being rubbed, and the Leaf-Braſs held under the Ivory Ball, the Electrick Vertue paſſed by the Line of Communication to the other End of the Gallery, and returned back again to the Ivory Ball, which attracted the Leaf-Braſs, and ſuſpended it as before. The whole Length of the Line was 147 Feet.

We then thought of trying whether the Attraction would not be ſtronger without doubling or returning the Line, which we found Means of doing in the Barn, where we had a Line of 124 Feet long, fourteen Feet of which hung perpendicular from the Silk Line; and now the Attraction was, as we then concluded, ſtronger than when the Line was returned, as in the matted Gallery.

July 3, having now brought with me the great Glaſs Tube, between Ten and Eleven in the Morning we went again into the Barn, carrying with us the ſolid Cane, and repeated the laſt mentioned Experiment with both the Tube and Cane; but the Attraction was not ſo ſtrong as in the preceding Evening, nor was there ſo great a Difference in the Attraction communicated by the ſolid Cane and Glaſs Tube, as one would have expected, conſidering the Difference of their Lengths and Diameters.

We then proceeded farther, by adding ſo much more Line as would make a Return to the other End of the Barn, the whole Length of the Line being now 293 Feet; and though the Line was ſo much lengthened, we found no perceivable Difference in the Attraction, the Ball attracting as ſtrongly as before. This encouraged us to add another Return; but upon beginning to rub the Tube, our Silk Lines broke, being not ſtrong enough to bear the Weight of the Line, when ſhaken by the Motion given it by rubbing the Tube. Upon this, having brought with me both Braſs and Iron Wire, inſtead of the Silk we put up ſmall Iron Wire; but this was too weak to bear the Weight of the Line. We then took Braſs Wire of a ſomewhat larger Size than

than that of Iron. This ſupported our Line of Communication; but though the Tube was well rubbed, yet there was not the leaſt Motion or Attraction given by the Ball, neither with the great Tube, which we made uſe of when we found the ſmall ſolid Cane to be ineffectual: By which we were now convinced, that the Succeſs we had before, depended upon the Lines that ſupported the Line of Communication, being Silk, and not upon their being ſmall, as before Trial I imagined it might be; the ſame Effect happening here as it did when the Line that is to convey the Electrick Vertue is ſupported by Packthread; *viz.* that when the Effluvia come to the Wire or Packthread that ſupports the Line, it paſſes by them to the Timber, to which each End of them is fixed, and ſo goes no farther forward in the Line that is to carry it to the Ivory Ball.

Finding that our Silk Threads were too weak to bear many Returns of Line, Mr. *Wheler* thought of another Way of managing them, ſo that fewer Returns might be upon each Silk Line; which was by placing two other croſs Lines ſome Feet below the upper ones; ſo that every other Turn of Line was ſuſpended by the lower croſs Line. By this Means there was but half the Weight of Line upon each Silk, of what there was when only two croſs Lines were made uſe of as before. By this Contrivance, we could add a much greater Length of Line, without Danger of breaking our Silk. We then put up a Line that was 666 Feet in Length, by eight Returns: Then the Leaf-Braſs being held on a Piece of white Paper under the Ivory Ball, and the Tube, with the other End of the Line

ſuſpended on it, being rubbed for ſome Time, the Leaf-Braſs was attracted as manifeſtly as it had been with much ſhorter Lines. We then repeated the Experiment with the little ſhort ſolid Cane, and found there was ſomewhat of an Attraction, but not near ſo great as with the large Tube.

Though the going and returning of the Electrick Effluvia was very ſurpriſing, yet we were willing to try how far the attractive Vertue might be carried in a continued right Line; the Method of doing which was thus: That End of the Line where the Attraction was to be made, was ſuſpended on a Silk Line that was fixed croſs the Garret Window on the North-ſide of the Houſe, which was by Eſtimation about forty Feet high; at about an hundred Feet from hence two Rods or Poles of about ten Feet long, and at two Feet diſtance from each other, were drove into the Ground, ſo as that they ſtood nearly perpendicular. Theſe were in the great Garden. Beyond theſe, in the great Field, that is ſeparated from the Garden by a deep Foſs, about the ſame Diſtance from the firſt, were another Pair of Poles fixed; then four others at a like Diſtance. Upon the Ends of theſe Poles were tied the croſs Lines of Silk, to ſupport the Line of Communication, which being laid on the Silk Lines, the Ivory Ball hanging in the Garret Window, and the other End of the Line being hung by a Loop on the Tube, the Leaf-Braſs was held under the Ball, and after the Tube had been rubbed for ſome Time, they called to me to let me know that there was an Attraction of the Leaf-Braſs. This was ſeveral Times repeated with Succeſs; then Mr. *Wheler* came into the Field, and rubbed the Tube himſelf,

himſelf, that I might ſee there was an Attraction; which I ſaw, though I perceived it not to be ſo ſtrong, as when the Attraction was carried by a longer Line, by returning it, as in the Experiments above-mentioned. The Length of the Line was 650 Feet. This was ſeveral Times repeated, but the Experiment being made in the Evening, at length the Dew began to fall. We began about Seven o'Clock, or ſome little Time after, but before Eight the Attraction ceaſed: But whether this was cauſed by the Dew falling, or by my being very hot, we could not poſitively ſay, but I rather impute it to the latter. This Experiment was made *July* 14, 1729.

Note, That though we call the carrying the Electrick Vertue by the Lines in this Poſition Horizontal, you are not to underſtand it in a ſtrict Senſe, as may be eaſily perceived by the Deſcription of the Method; and That as the Line ſwagged down much below the Silk Lines that ſupported it, in the middle Part between thoſe Lines, it was ſome Feet longer than the Diſtance of the Poles.

Some Days after this Experiment was repeated from the Turret Cloſet Window, when the Line was 765 Feet, and the Attraction was no leſs perceivable than in the Experiment above-mentioned.

More Experiments made at Mr. Wheler's, *ſhewing that large Surfaces may be impregnated with Electrick Effluvia.*

A large Map of the World, that had twenty-ſeven ſquare Feet in it; a Table-Cloth containing fifty-nine ſquare Feet; theſe ſuſpended on the Tube by Pack-

Packthreads, became Electrical. An Umbrello, ſuſpended by a Packthread tied to the Handle of it, became ſtrongly Electrical.

An Experiment propoſed by Mr. Wheler, *to ſee whether the Electrick Vertue would be any Way hindred by the magnetical Effluvia of a Loadſtone.*

This had a ſmall Key hung by one of its arming Irons, and the Stone, together with the Key hung to it, were ſuſpended on the Tube by a Packthread; then the Tube being rubbed, the Key and Stone both attracted the Leaf-Braſs, the Attraction being the ſame as that of other Bodies.

An Experiment made to ſhew that the Electrick Vertue is carried ſeveral Ways at the ſame Time, and may be conveyed to conſiderable Diſtances.

There was made three Stands, each compoſed of two upright Pieces of Fir, fixed perpendicular, near the Ends of a long ſquare Board, diſtant from each other near a Foot and a half. Upon the Tops of theſe were tied Threads of Silk to ſupport the Lines of Communication with the Tube and the attracting Bodies. One of theſe Stands was placed in the great Parlour, near the farther End; another in the little Parlour, and a third in the Hall, which was between the two Parlours: As the other two were one of them to the right, the other to the left Hand, this laſt was placed near the Hall-Window forwards; the two firſt were about fifty Feet, the other about twenty Feet from the Place where

where the Tube was held ; then there were taken three ſmall ſquare Pieces of Wood, that were tied to three Lines of Packthread : Theſe were of about the Lengths above-mentioned. They were laid on the Silk Lines, and by Loops at the other Ends were ſuſpended on the Tube; then the Leaf-Braſs being held under the Pieces of Wood, and the Tube rubbed, they all of them attracted the Leaf-Braſs at the ſame Time. Some Time after, in my Abſence, Mr. *Wheler* tried a red hot Poker, and found that the Attraction was the ſame as when cold. He alſo ſuſpended a live Chick upon the Tube, by the Legs, and found that the Breaſt of the Chick was ſtrongly Electrical.

At Mr. Godfrey's *I made the following Experiments ; ſhewing that the* Electrick Vertue *may be carried from the Tube, without touching the Line of Communication, by only being held near it.*

The firſt of theſe Experiments was made the 5th of *Auguſt*, 1729. I ſhall here mention ſome of the moſt conſiderable ones; but as I did not always ſet down the Day of the Month, ſome of them may not be related in the Order of Time they were made ; nor did I always mention the Length of the Lines, theſe not being thought to be abſolutely neceſſary.

I took a Piece of a Hair-Line, ſuch as Linnen-Cloaths are dried on, of about eleven Feet in Length ; which, by a Loop at the upper End of it, was ſuſpended on a Nail, that was drove into one of the Rafters in the Garret, and had at its lower End

a leaden Weight of fourteen Pounds hung to it by an Iron Ring: then the Leaf-Braſs was laid under the Weight, and the Tube rubbed, and being held near the Line without touching it, the Lead-Weight attracted and repelled the Leaf-Braſs for ſeveral times together, to the Hight of at leaſt three, if not four Inches. If the Tube was held three or four Feet above the Weight, there would be an Attraction; but if it were held higher up, ſo as to be near the Rafter where the Weight was hung by the Hair-Line, there would be no Attraction.

An Experiment, ſhewing that the Electrick Vertue *may be carried ſeveral Ways at the ſame Time, by a Line of Communication, without touching the ſaid Line.*

There were taken two Hair-Lines, of between four and five Feet long; to each of theſe was tied a ſquare Piece of Cork, by Packthread; the Lines were ſuſpended by Loops at their upper Ends, upon two Nails; near the lower Ends there was tied to the Hair-Lines a Piece ef Packthread, by which there was a Communication between the two Hair-Lines; then the Leaf-Braſs laid under the Corks, the Tube being rubbed, and held near one of the Lines, both the Corks attracted; but that which was fartheſt, much ſtronger than that, near which the Tube was held. About the Middle of the Line of Communication they both drew with equal Force.

Some

Some Time after, at Mr. Wheler's, *we made the following Experiment, in order to try whether the* Electrick Attraction *be proportional to the Quantity of Matter in Bodies.*

There were made two Cubes of Oak, of about ſix Inches Square, the one ſolid, the other hollow: Theſe were ſuſpended by two Hair-Lines, nearly after the ſame Manner as in the Experiment above-mentioned; the Diſtance of the Cubes from each other, was by Eſtimation, about fourteen or fifteen Feet; the Line of Communication being tied to each Hair-Line, and the Leaf-Braſs placed under the Cubes, the Tube was rubbed and held over the Middle of the Line, and as near as could be gueſſed, at equal Diſtances from the Cubes, when both of them attracted and repelled the Leaf-Braſs at the ſame Time, and to the ſame Hight; ſo that there ſeemed to be no more Attraction in the ſolid than in the hollow Cube; yet I am apt to think that the Electrick Effluvia paſs through all the interior Parts of the ſolid Cube, though no Part but the Surface attracts; for from ſeveral Experiments it appears, that if any other Body touches that which attracts, its Attraction ceaſes till that Body be removed, and the other be again excited by the Tube.

A Continuation of the Experiments made at Mr. Godfrey's.

I next went on with an Experiment, to ſee if the Electrick Vertue might not be conveyed to a Rod, without inſerting it into the Bore of the Tube, or without touching the Rod, which I found to ſucceed,

by ſuſpending the Rod either by Lines of Silk, or by Pieces of Horſe-Hair Fiſhing-Lines, placing a Ball of Cork on the leſſer End of the Rod.

Auguſt 13, I took a large Pole that was twenty-ſeven Feet long, two Inches and a half Diameter at the great End, and at the leſſer about half an Inch: It was that Sort of Wood they call Horſe-Beech, with the Rind on. This was ſuſpended by two Hair-Lines of about four Feet and a half in Length; the firſt Line was about two Feet from the great End of the Pole, the other about eight Feet from the leſſer End; ſo that the Pole hung horizontal. At the little End of the Pole was hung a Ball of Cork about an Inch and a half Diameter by a Packthread about a Foot long, and a ſmall leaden Ball upon the Cork to keep the Packthread extended: Then the Leaf-Braſs being laid under the Cork, the Tube rubbed and held near the great End of the Pole, the Cork Ball drew the Leaf-Braſs ſtrongly to the Hight of an Inch, if not more: Then the Leaf-Braſs being held under ſeveral Parts of the Pole, it was attracted by it, as Mr. *Godfrey* obſerved, but not near ſo ſtrongly as the Cork did.

About the Beginning of September *I made the following Experiment, which ſhews that the* Electrick Effluvia *will be carried in a* Circle, *and be communicated from one* Circle *to another.*

There was taken a Hoop of about two Feet two Inches Diameter; this I ſuſpended by a Hair-Line upon a Nail drove into a Beam; the Line was about four Feet long; then the Leaf-Braſs being laid under the Hoop, the Tube was rubbed, and held within

within the Hoop, near the upper Side of it, without touching it by ſeveral Inches: Then the lower Part of the Hoop attracted and repelled the Leaf-Braſs ſtrongly; but when held near the lower Part, there was very little, if any Attraction. If the Tube was held near the outſide of the Hoop, it attracted; but ſtrongeſt, when at the ſame Time it was held near the Knot of the Hair-Line the Hoop was ſuſpended by. To this Hoop there was tied a leſſer Hoop of about a Foot and a half Diameter: It was tied to it by Packthread, ſo as to hang below it about two Inches; they were ſuſpended together by the Hair-Line; then the Leaf-Braſs and the Tube being prepared, as hath been mentioned before, the Tube being held near the upper Hoop, the lower Part of the lower Hoop attracted ſtrongly, and when held near the upper Part of the lower Hoop, but very weakly; but when held near the lower Part of the lower Hoop, there was no Attraction.

On the 15*th of* September *I made the following Experiment, which ſhews, that the* Electrick Effluvia *have the ſame Effect in a* Circle, *when its Poſition is horizontal.*

I took a large Hoop, of ſomewhat more than three Feet Diameter, and Breadth of about two Inches and a half; to this was tied at near equal Diſtances, four Lines: They were what they call Twine, which is of three Threads of Packthread twiſted together, each about two Feet eight Inches long. Theſe were tied with their Ends together to a Hair-Line of about two Feet and a half long, by which the Hoop was hung

hung on a Nail, as in the other Experiments, ſo that the Hoop hung now in an horizontal Poſition: Then the Leaf-Braſs being laid under the Edge of the Hoop, at between two and three Inches below it, the Tube being rubbed, and held between the Cords without touching them, the Leaf-Braſs was attracted and repelled for ſeveral times together; but when held near the outſide of the Hoop, oppoſite to that Part where the Leaf-Braſs lay, the Attraction was much ſtronger.

About the latter End of Autumn, and the Beginning of the Winter in 1729, I reſumed my Enquiry after other Electrick Bodies, to ſee what Addition I could make to the Catalogue of thoſe mentioned above, in Page and found many more that have the ſame Property, and may be excited to attract by the ſame Method. As for Inſtance, the dry withered Leaves of Reeds and Flags, Graſs and Corn, both Leaves and Straw; the Leaves of Trees, as thoſe of the Laurel, the Oak, the Walnut, the Cheſnut, Hazle-nut, Apple and Pear-tree Leaves; ſo that we may conclude, that the Leaves of all Vegetables have this Attractive Vertue.

I ſhall now give an Account of the Experiments made at my Chamber in the Year 1730.

March the 23d, I diſſolved Soap in the *Thames*-Water, then I ſuſpended a Tobacco-Pipe by a Hair-Line, ſo as that it hung nearly horizontal, with the Mouth of the Bowl downwards; then having dipped it in the Soap-Liquor, and blown a Bubble, the Leaf-Braſs laid on a Stand under it, the Tube being rubbed, the Braſs was attracted by the Bubble, when the

the Tube was held near the Hair-Line. Then I repeated the Expriment with another Bubble, holding the Tube near the little End of the Pipe, and the Attraction was now much greater, the Leaf-Braſs being attracted to the Hight of near two Inches.

March the 25th, I repeated this Experiment after a ſomewhat different Manner: The Pipe was now ſuſpended by two Lines of white ſewing Silk, of about five Feet and a half long; theſe were hung upon two Nails drove into the Beam of my Chamber, diſtant from each other about a Foot, by Loops at the other End of the Lines, by which the Pipe was ſuſpended; then the Bubble being blown, by holding the Tube to the little End of the Pipe, the Bubble attracted the Leaf-Braſs to the Hight of near four Inches. This Experiment was made to ſee whether fluid Bodies would not have an Electricity communicated to them.

April 8, 1730, I made the following Experiment on a Boy between eight and nine Years of Age. His Weight, with his Cloaths on, was forty-ſeven Pounds ten Ounces. I ſuſpended him in a horizontal Poſition, by two Hair-Lines, ſuch as Cloaths are dried on: They were about thirteen Feet long, with Loops at each End. There was drove into the Beam of my Chamber, which was a Foot thick, a Pair of Hooks oppoſite to each other, and two Feet from theſe another Pair in the ſame manner. Upon theſe Hooks the Lines were hung by their Loops, ſo as to be in the Manner of two Swings, the lower Parts hanging within about two Feet of the Floor of the Room: Then the Boy was laid on theſe Lines with his Face downwards, one of the Lines being put under his Breaſt, the other

under his Thighs: Then the Leaf-Braſs was laid on a Stand, which was a round Board of a Foot Diameter, with white Paper paſted on it, ſupported on a Pedeſtal of a Foot in Hight, which I often made uſe of in other Experiments, though not till now mentioned: Upon the Tube's being rubbed, and held near his Feet, without touching them, the Leaf-Braſs was attracted by the Boy's Face with much Vigour, ſo as to riſe to the Hight of eight, and ſometimes ten Inches. I put a great many Pieces on the Board together, and almoſt all of them came up together at the ſame Time. Then the Boy was laid with his Face upwards, and the hind Part of his Head, which had ſhort Hair on, attracted, but not at quite ſo great a Hight as his Face did. Then the Leaf-Braſs was placed under his Feet, his Shoes and Stockings being on, and the Tube held near his Head, his Feet attracted, but not altogether at ſo great a Hight as his Head: Then the Leaf-Braſs was again laid under his Head, and the Tube held over it, but there was then no Attraction, nor was there any when the Leaf-Braſs was laid under his Feet, and the Tube held over them.

April the 16th, I repeated the Experiment with the Boy, but now the Attraction was not quite ſo ſtrong as at the firſt, the Braſs not riſing higher than to about ſix Inches. His Hands being ſtretched nearly horizontal, I placed a ſmall Stand with Leaf-Braſs under each Hand, and under his Face the great one, furniſhed as the others; when the excited Tube being held near his Feet, there was an Attraction by his Hands and Face at the ſame Time. I then gave him the Top of a Fiſhing-Rod to hold in his Hand; there was a

Ball

Ball of Cork ſtuck on the little End of it, under which the Leaf-Braſs being laid, and the Tube rubbed and held near his Feet, the Ball attracted the Leaf-Braſs to the Hight of two Inches, and repelled it, and attracted for ſeveral Times together with great Vigour.

April 21, I again repeated the Experiment on the Boy; and now he attracted much ſtronger than at the firſt: The Leaf-Braſs roſe to his Face at the Hight of more than twelve Inches. Then I gave the Boy to hold in each Hand the Tops of two Fiſhing-Rods, with a Ball of Cork on each of their leſſer Ends; then a ſmall Stand being ſet under each Ball, with the Leaf-Braſs on it, the Tube being rubbed, and held near his Feet, both the Corks attracted and repelled together ſtrongly. The Length of the Poles were each of them about ſeven Feet. Then the Boy was laid on his left Side, and a Fiſhing-Rod, of near twelve Feet in Length, given him to hold with both his Hands; there was a ſmall Ball of Cork at the End of the Rod, that was an Inch and three quarters Diameter: Then all Things being prepared, the Tube held near the Boy's Feet, the Cork Ball attracted and repelled the Leaf-Braſs with Force to the Hight of at leaſt two Inches.

Note, That when I ſpeak of holding the Tube near the Boy's Feet, I mean over againſt the Soles of his Feet; and when near his Head, is to be underſtood the Crown of his Head; for when the Tube is held above, or over his Legs, the Attraction is not ſo ſtrongly communicated to the other Parts of his Body.

By theſe Experiments we ſee that Animals receive a greater Quantity of Electrick Effluvia, and that they may be conveyed from them ſeveral Ways at the ſame Time to conſiderable Diſtances, wherever they meet with a Paſſage proper for their Conveyance, and there exert their Attracting Power.

In theſe Experiments, beſides the large Stand above-mentioned, I made uſe of two ſmall ones, which, as I found them very uſeful, it may not be improper to deſcribe them. The Tops of them were three Inches Diameter; they were ſupported by a Column of about a Foot in Hight, their Baſes of about four Inches and a half: They were turned of *Lignum vitæ*; their Tops and Baſes made to skrew on for Convenience of Carriage. Upon the Tops were paſted white Paper. When the Leaf-Braſs is laid on any of theſe Stands, I find it is attracted to a much greater Hight than when laid on a Table, and at leaſt three Times higher than when laid on the Floor of a Room.

June 20, *I made the following Experiment, ſhewing that the* Attraction *and* Repulſion *is as ſtrong, if not ſtronger, and that the* Effluvia *may be carried to great Lengths, without touching the Line by the Tube.*

There was taken a Line of Packthread 231 Feet in Length; it was ſupported on two croſs Lines of blue Silk; the Diſtance of theſe Lines was near eighteen Feet. About four Feet below one of theſe Lines, was put up another Silk Line of the ſame Colour: To this was tied one End of the Packthread; at the other End the Ivory Ball hung; the Line was returned over

the croſs Lines thirteen times; then the Leaf-Braſs being laid under the Ball, upon one of the ſmall Stands, and the Tube excited, the Ball attracted and repelled to the Hight of one of its Diameters, which was about an Inch and a quarter.

I have, by ſeveral Trials lately made, found that rubbing the Tube, and putting it up between the Returns of the Line in ſeveral Places, before I go with the Tube to the End of the Line, much facilitates, and cauſes the Attraction much ſooner than when one ſtands with the Tube and applies it to the End of the Line only.

About the middle of July *I went into the Country, and* Auguſt 1, *at Mr.* Wheler's, *we made the following Experiment; being an Attempt to ſee how far the* Electrick Vertue *might be carried forward in a Line, without touching the ſame.*

This Experiment was made by carrying the Line out of the Great Parlour Window into the Garden, and down the great Field before it. The Line was ſupported by fifteen Pair of Poles; each Pair had a Line of blue Silk tied from one Pole to the other, the Length of about four Feet, equal to the Diſtance of the two Poles: About ten Feet from the Window there was a Silk Line put up croſs the Room, upon which that Part of the Line hung that had the Ivory Ball upon it. Below the croſs Line of the fartheſt Pair of Poles was placed another croſs Line, four Feet from the Ground, to which was faſtened the other End of the communicating Line, as mentioned in the Experiment above: Then the Leaf-Braſs and Tube being pre-

pared as uſual, the Tube being held over the Line at ſeveral Diſtances, beginning towards that End where the Ball hung, and ſo proceeding towards the farther End of the Line, the Leaf-Braſs was attracted at the Stations not exceeding two or three hundred Feet, pretty ſtrongly; but ſtill grew weaker as we came towards the farther End of the Line: Yet even at the End of the Line the Leaf-Braſs would be lifted by the Ball, when the Tube touched the Line, whoſe Length was 886 Feet.

I ſhould now have given ſome Account of the Diſcovery I made the laſt Year concerning the Attraction of coloured Bodies, ſhewing that they attract more or leſs, according to what Colours they are of, though the Subſtance be the ſame, and of equal Weight and Bigneſs; only I ſhall obſerve, that I find the Red, Orange or Yellow, attract at leaſt three or four times ſtronger than Green, Blue or Purple: But having very lately found out a new and more accurate Method of making theſe Experiments, I muſt beg Leave to proceed farther with them, before I communicate them. I am,

SIR,

Charter-Houſe,
Feb. 8, 173⅝.

Your Humble Servant,

STEPHEN GRAY.

VI. *Cur-*